



T-46-09-05

378

# 54AC/74AC378

## Parallel D Register with Enable

### General Description

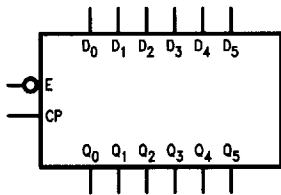
The 'AC378 is a 6-bit register with a buffered common Enable. This device is similar to the 'AC174, but with common Enable rather than common Master Reset.

### Features

- 6-bit high-speed parallel register
- Positive edge-triggered D-type inputs
- Fully buffered common clock and enable inputs
- Input clamp diodes limit high-speed termination effects
- Standard Military Drawing (SMD)
  - 'AC378: 5962-91605

**Ordering Code:** See Section 8

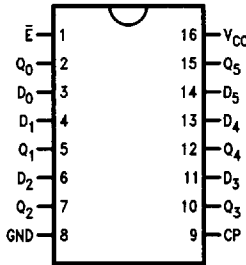
### Logic Symbols



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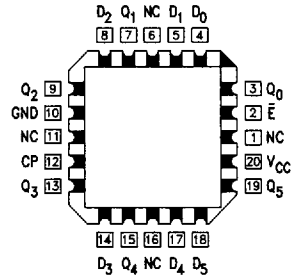
### Connection Diagrams

Pin Assignment for DIP, SOIC and Flatpak



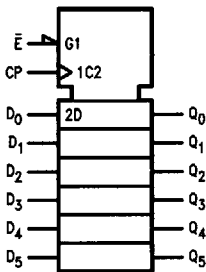
TL/F/10231-2

Pin Assignment for LCC



TL/F/10231-3

IEEE/IEC



TL/F/10231-4

| Pin Names                      | Description                            |
|--------------------------------|--|
| E                              | Enable Input (Active LOW)              |
| D <sub>0</sub> -D <sub>5</sub> | Data Inputs                            |
| CP                             | Clock Pulse Input (Active Rising Edge) |
| Q <sub>0</sub> -Q <sub>5</sub> | Outputs                                |

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### Functional Description

The 'AC378 consists of six edge-triggered D-type flip-flops with individual D inputs and Q outputs. The Clock (CP) and Enable (E) inputs are common to all flip-flops.

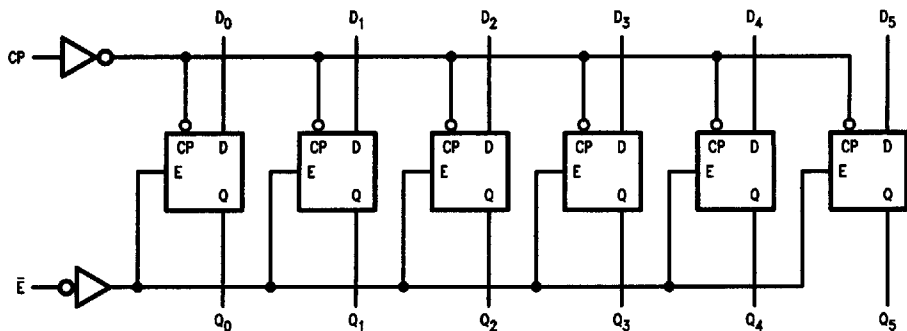
When the E input is LOW, new data is entered into the register on the LOW-to-HIGH transition of the CP input. When the E input is HIGH the register will retain the present data independent of the CP input.

### Truth Table

| Inputs    |    |       | Output    |
|-----------|----|-------|-----------|
| $\bar{E}$ | CP | $D_n$ | $Q_n$     |
| H         | ↗  | X     | No Change |
| L         | ↗  | H     | H         |
| L         | ↗  | L     | L         |

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Immaterial  
 ↗ = LOW-to-HIGH Clock Transition

### Logic Diagram



TL/F/10231-5

Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

### Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

|  |                          |
|--|--------------------------|
| Supply Voltage ( $V_{CC}$ )  | -0.5V to +7.0V           |
| DC Input Diode Current ( $I_{IK}$ )                                    |                          |
| $V_I = -0.5V$  | -20 mA                   |
| $V_I = V_{CC} + 0.5V$  | +20 mA                   |
| DC Input Voltage ( $V_I$ )   | -0.5V to $V_{CC} + 0.5V$ |
| DC Output Diode Current ( $I_{OK}$ )                                   |                          |
| $V_O = -0.5V$  | -20 mA                   |
| $V_O = V_{CC} + 0.5V$  | +20 mA                   |
| DC Output Voltage ( $V_O$ )  | -0.5V to $V_{CC} + 0.5V$ |
| DC Output Source or Sink Current ( $I_O$ )                             | ±50 mA                   |
| DC $V_{CC}$ or Ground Current per Output Pin ( $I_{CC}$ or $I_{GND}$ ) | ±50 mA                   |
| Storage Temperature ( $T_{STG}$ )                                      | -65°C to +150°C          |
| Junction Temperature ( $T_J$ )   |                          |
| CDIP   | 175°C                    |
| PDIP   | 140°C                    |

**Note 1:** Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation of FACT™ circuits outside databook specifications.

### Recommended Operating Conditions

|   |                 |
|---|-----------------|
| Supply Voltage ( $V_{CC}$ )                     | 2.0V to 6.0V    |
| 'AC   |                 |
| Input Voltage ( $V_I$ )                         | 0V to $V_{CC}$  |
| Output Voltage ( $V_O$ )                        | 0V to $V_{CC}$  |
| Operating Temperature ( $T_A$ )                 |                 |
| 74AC  | -40°C to +85°C  |
| 54AC  | -55°C to +125°C |
| Minimum Input Edge Rate ( $\Delta V/\Delta t$ ) |                 |
| 'AC Devices                                     |                 |
| $V_{IN}$ from 30% to 70% of $V_{CC}$            |                 |
| $V_{CC}$ @ 3.3V, 4.5V, 5.5V                     | 125 mV/ns       |

### DC Characteristics for 'AC Family Devices

| Symbol   | Parameter                         | $V_{CC}$ (V) | 74AC                |      | 54AC                                  |  | 74AC                                 |  | Units | Conditions  |
|----------|-----------------------------------|--------------|---------------------|------|---------------------------------------|--|--------------------------------------|--|-------|---|
|          |                                   |              | $T_A = +25^\circ C$ |      | $T_A = -55^\circ C$ to $+125^\circ C$ |  | $T_A = -40^\circ C$ to $+85^\circ C$ |  |       |   |
|          |                                   |              | Typ                 |      | Guaranteed Limits                     |  |                                      |  |       |   |
| $V_{IH}$ | Minimum High Level Input Voltage  | 3.0          | 1.5                 | 2.1  | 2.1                                   |  | 2.1                                  |  | V     | $V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$   |
|          |                                   | 4.5          | 2.25                | 3.15 | 3.15                                  |  | 3.15                                 |  |       |   |
|          |                                   | 5.5          | 2.75                | 3.85 | 3.85                                  |  | 3.85                                 |  |       |   |
| $V_{IL}$ | Maximum Low Level Input Voltage   | 3.0          | 1.5                 | 0.9  | 0.9                                   |  | 0.9                                  |  | V     | $V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$   |
|          |                                   | 4.5          | 2.25                | 1.35 | 1.35                                  |  | 1.35                                 |  |       |   |
|          |                                   | 5.5          | 2.75                | 1.65 | 1.65                                  |  | 1.65                                 |  |       |   |
| $V_{OH}$ | Minimum High Level Output Voltage | 3.0          | 2.99                | 2.9  | 2.9                                   |  | 2.9                                  |  | V     | $I_{OUT} = -50 \mu A$   |
|          |                                   | 4.5          | 4.49                | 4.4  | 4.4                                   |  | 4.4                                  |  |       |   |
|          |                                   | 5.5          | 5.49                | 5.4  | 5.4                                   |  | 5.4                                  |  |       |   |
|          |                                   | 3.0          |                     | 2.56 | 2.4                                   |  | 2.46                                 |  | V     | * $V_{IN} = V_{IL}$ or $V_{IH}$<br>$I_{OH} = -12 \mu A$<br>$-24 \mu A$<br>$-24 \mu A$ |
|          |                                   | 4.5          |                     | 3.86 | 3.7                                   |  | 3.76                                 |  |       |   |
|          |                                   | 5.5          |                     | 4.86 | 4.7                                   |  | 4.76                                 |  |       |   |
| $V_{OL}$ | Maximum Low Level Output Voltage  | 3.0          | 0.002               | 0.1  | 0.1                                   |  | 0.1                                  |  | V     | $I_{OUT} = 50 \mu A$  |
|          |                                   | 4.5          | 0.001               | 0.1  | 0.1                                   |  | 0.1                                  |  |       |   |
|          |                                   | 5.5          | 0.001               | 0.1  | 0.1                                   |  | 0.1                                  |  |       |   |
|          |                                   | 3.0          |                     | 0.36 | 0.5                                   |  | 0.44                                 |  | V     | * $V_{IN} = V_{IL}$ or $V_{IH}$<br>$I_{OL} = 12 \mu A$<br>$24 \mu A$<br>$24 \mu A$    |
|          |                                   | 4.5          |                     | 0.36 | 0.5                                   |  | 0.44                                 |  |       |   |
|          |                                   | 5.5          |                     | 0.36 | 0.5                                   |  | 0.44                                 |  |       |   |
| $I_{IN}$ | Maximum Input Leakage Current     | 5.5          |                     | ±0.1 | ±1.0                                  |  | ±1.0                                 |  | μA    | $V_I = V_{CC}, GND$   |

\*All outputs loaded; thresholds on input associated with output under test.

**DC Characteristics for 'AC Family Devices** (Continued)

| Symbol           | Parameter                        | V <sub>CC</sub> (V) | 74AC                   |                   | 54AC                             |  | 74AC                            |  | Units | Conditions                               |
|------------------|----------------------------------|---------------------|------------------------|-------------------|----------------------------------|--|---------------------------------|--|-------|--|
|                  |                                  |                     | T <sub>A</sub> = +25°C |                   | T <sub>A</sub> = -55°C to +125°C |  | T <sub>A</sub> = -40°C to +85°C |  |       |  |
|                  |                                  |                     | Typ                    | Guaranteed Limits |                                  |  |                                 |  |       |  |
| I <sub>OLD</sub> | †Minimum Dynamic Output Current  | 5.5                 |                        |                   | 50                               |  | 75                              |  | mA    | V <sub>OLD</sub> = 1.65V Max             |
| I <sub>OHD</sub> |                                  | 5.5                 |                        |                   | -50                              |  | -75                             |  | mA    | V <sub>OHD</sub> = 3.85V Min             |
| I <sub>CC</sub>  | Maximum Quiescent Supply Current | 5.5                 | 4.0                    |                   | 80.0                             |  | 40.0                            |  | µA    | V <sub>IN</sub> = V <sub>CC</sub> or GND |

†Maximum test duration 2.0 ms, one output loaded at a time.

Note: I<sub>IN</sub> and I<sub>CC</sub> @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V<sub>CC</sub>.

I<sub>CC</sub> for 54AC @ 25°C is identical to 74AC @ 25°C.

**AC Electrical Characteristics:** See Section 2 for Waveforms

| Symbol           | Parameter                              | V <sub>CC</sub> * (V) | 74AC   |            |             | 54AC   |             | 74AC  |             | Units | Fig. No. |
|------------------|--|-----------------------|--|------------|-------------|--|-------------|---|-------------|-------|----------|
|                  |  |                       | T <sub>A</sub> = +25°C<br>C <sub>L</sub> = 50 pF |            |             | T <sub>A</sub> = -55°C to +125°C<br>C <sub>L</sub> = 50 pF |             | T <sub>A</sub> = -40°C to +85°C<br>C <sub>L</sub> = 50 pF |             |       |          |
|                  |  |                       | Min  | Typ        | Max         | Min  | Max         | Min   | Max         |       |          |
| f <sub>max</sub> | Maximum Clock Frequency                | 3.3<br>5.0            | 125<br>160                                       | 160<br>200 |             | 95<br>95   |             | 110<br>145  | MHz         |       |          |
| t <sub>PLH</sub> | Propagation Delay CP to Q <sub>n</sub> | 3.3<br>5.0            | 2.5<br>1.5                                       | 8.5<br>6.0 | 11.0<br>8.0 | 1.5<br>1.5   | 12.0<br>9.0 | 2.5<br>1.5  | 12.5<br>9.0 | ns    | 2-3, 4   |
| t <sub>PHL</sub> | Propagation Delay CP to Q <sub>n</sub> | 3.3<br>5.0            | 2.5<br>1.5                                       | 8.0<br>5.5 | 10.5<br>7.5 | 1.5<br>1.5   | 12.0<br>9.0 | 2.5<br>1.5  | 11.0<br>8.0 | ns    | 2-3, 4   |

\*Voltage Range 3.3 is 3.3V ±0.3V

Voltage Range 5.0 is 5.0V ±0.5V

**AC Operating Requirements:** See Section 2 for Waveforms

| Symbol         | Parameter                                    | V <sub>CC</sub> * (V) | 74AC   |                    | 54AC   |            | 74AC  |            | Units | Fig. No. |
|----------------|--|-----------------------|--|--------------------|--|------------|---|------------|-------|----------|
|                |  |                       | T <sub>A</sub> = +25°C<br>C <sub>L</sub> = 50 pF |                    | T <sub>A</sub> = -55°C to +125°C<br>C <sub>L</sub> = 50 pF |            | T <sub>A</sub> = -40°C to +85°C<br>C <sub>L</sub> = 50 pF |            |       |          |
|                |  |                       | Typ  | Guaranteed Minimum |  |            |   |            |       |          |
| t <sub>s</sub> | Setup Time, HIGH or LOW D <sub>n</sub> to CP | 3.3<br>5.0            | 1.5<br>1.0                                       | 3.0<br>2.0         |  | 4.0<br>4.0 |   | 3.5<br>2.5 | ns    | 2-7      |
| t <sub>h</sub> | Hold Time, HIGH or LOW D <sub>n</sub> to CP  | 3.3<br>5.0            | 1.0<br>1.0                                       | 2.0<br>2.0         |  | 4.0<br>4.0 |   | 2.0<br>2.0 | ns    | 2-7      |
| t <sub>s</sub> | Setup Time, HIGH or LOW, $\bar{E}$ to CP     | 3.3<br>5.0            | 0<br>0   | 2.0<br>2.0         |  | 2.5<br>2.5 |   | 2.0<br>2.0 | ns    | 2-7      |
| t <sub>h</sub> | Hold Time, HIGH or LOW, $\bar{E}$ to CP      | 3.3<br>5.0            | 1.0<br>1.0                                       | 2.0<br>2.0         |  | 4.0<br>4.0 |   | 2.0<br>2.0 | ns    | 2-7      |
| t <sub>w</sub> | CP Pulse Width HIGH or LOW                   | 3.3<br>5.0            | 3.0<br>2.0                                       | 4.5<br>3.5         |  | 6.5<br>6.5 |   | 5.5<br>4.0 | ns    | 2-4      |

\*Voltage Range 3.3 is 3.3V ±0.3V

Voltage Range 5.0 is 5.0V ±0.5V

**Capacitance**

| Symbol          | Parameter                     | Typ | Units | Conditions             |
|-----------------|-------------------------------|-----|-------|------------------------|
| C <sub>IN</sub> | Input Capacitance             | 4.5 | pF    | V <sub>CC</sub> = OPEN |
| C <sub>PD</sub> | Power Dissipation Capacitance | 28  | pF    | V <sub>CC</sub> = 5.0V |